

AMENDMENTS TO THE CLAIMS

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) An electric drill apparatus having a low profile, comprising:
 - an annular cutter for cutting at a high rotational speed, and having a main body and a plurality of cutting blades comprised of cemented carbide tips fixed on its lower end, the main body of the annular cutter being substantially non-tapered;
 - a motor for rotating at a high speed suitable for a cutting operation of the annular cutter with the cemented carbide tips;
 - a rotary shaft assembly for rotating the annular cutter attached to its leading end about an axis, the direction of which is different from that of an axis of a rotating shaft of the motor;
 - a rotation reduction mechanism disposed between the motor and rotary shaft assembly for transmitting a driving force of the motor to the annular cutter through the rotary shaft assembly;
 - a feed mechanism responsive to an operation of a manual handle, for moving the rotary shaft assembly along with a straight line to advance or retract the annular cutter attached to the rotary shaft assembly with respect to a workpiece; and
 - an adhesion base disposed below a body of the electric drill apparatus for securing the electric drill apparatus to the workpiece.
2. (Original) An electric drill apparatus according to Claim 1 further comprising an automatic motor stopping/re-driving mechanism which comprises:
 - a main switching element connected in series between the motor and a power supply;
 - a current detector for detecting a load current flowing through the motor;
 - a determination unit for determining whether the load current detected by the current detector exceeds a first predetermined reference value; and

a control unit for controlling the main switching element to turn on/off, wherein when the determination unit determines that the load current exceeds the first reference value, the control unit turns off the main switching element to shut off the current flowing through the motor, and subsequently when the determination unit determines that the load current decreases to be smaller than the first reference value, the control unit turns on the main switching element at a predetermined time after the determination, to supply the current from the power supply to the motor.

3. (Original) An electric drill apparatus according to Claim 1, wherein the adhesion base comprises a magnetic base having a magnet.

4. (Previously presented) An electric drill apparatus according to Claim 1, wherein the axis of the rotary shaft assembly is substantially perpendicular to the rotating shaft of the motor.

5. (Currently Amended) An electric drill apparatus, comprising:

~~a motor for rotating an annular cutter;~~

a motor for rotating the annular cutter;

a rotary shaft assembly for rotating the annular cutter attached to its leading end about an axis, the direction of which is different from that of an axis of a rotating shaft of the motor;

a feed mechanism responsive to an operation of a manual handle, for moving the rotary shaft assembly along with a straight line to advance or retract the annular cutter attached to the rotary shaft assembly with respect to a workpiece;

a main switching element connected in series between the motor and a power supply;

a current detector for detecting a load current flowing through the motor;

a first determination unit for determining whether the load current detected by the current detector exceeds a first predetermined reference value; and

a control unit for controlling the main switching element to turn on/off, wherein when the first determination unit determines that the load current exceeds the first reference value, the control unit turns off the main switching element to shut off the current flowing through the motor, and subsequently when the first determination unit determines that the load

current decreases to be smaller than the first reference value, the control unit turns on the main switching element only after waiting at least a predetermined time after the determination, to supply the current from the power supply to the motor.

6. (Previously presented) An electric drill apparatus according to Claim 5, further comprising:

a rotary shaft assembly for rotating the annular cutter attached to its leading end about an axis, the direction of which is different from that of an axis of a rotating shaft of the motor.

7. (Previously presented) An electric drill apparatus according to Claim 6, wherein the axis of the rotary shaft assembly is substantially perpendicular to the rotating shaft of the motor.

8. (Original) An electric drill apparatus according to Claim 5, wherein the annular cutter comprises cutting blades comprised of cemented carbide chips fixed on its lower end and at positions opposing a plurality of swarf exhaust grooves, respectively.

9. (Original) An electric drill apparatus according to Claim 5, further comprising:

a second determination unit for determining whether the load current detected by the current detector exceeds a second reference value lower than the first reference value; and

a load condition indication unit for indicating a normal load condition when the second determination unit determines that the load current does not exceed the second reference value, and indicating an overload condition when the second determination unit determines that the load current exceeds the second reference value.

10. (Currently Amended) An electric drill apparatus according to Claim 5, wherein

the current detector is a fixed resistor connected in series with the motor and main switching element to output a voltage obtained across the resistor correspondingly to the load current, and

the first determination ~~means~~ unit is adapted to receive the voltage corresponding to the load current, and compare the voltage with a first reference voltage corresponding to the first reference value to determine whether the load current exceeds the first reference value.

11. (Original) An electric drill apparatus according to Claim 9, wherein

the current detector is a fixed resistor connected in series with the motor and the main switching element to output a voltage obtained across the resistor correspondingly to the load current, and

the second determination unit is adapted to receive the voltage corresponding to the load current, and compare the voltage with a second reference voltage corresponding to the second reference value to determine whether the load current exceeds the second reference value.

12. (Previously Presented) An electric drill apparatus according to Claim 5, wherein the control unit comprises:

an on-state self hold unit including a first switching element, for turning on the first switching element when a starting switch is turned on, and holding it in the on-state even after the starting switch is turned off;

a control signal supply unit for supplying an on-control signal for turning on the main switching element when the first switching element is in the on-state;

a second switching element which turns on when the first determination unit determines that the load current exceeds the first reference value, to prevent the control signal supply means from generating the on-control signal even when the first switching element is in the on-state; and

a unit, responsive to the determination by the first determination unit that the load current is reduced below the first reference value after the load current exceeded the first reference value, for turning off the second switching element at a predetermined time after the determination.

13. (Previously Presented) An electric drill apparatus according to Claim 5, wherein the main switching element is a triac, and the control unit comprises:

an on-state self hold unit including a first switching transistor, for turning on the first switching transistor when a starting switch is turned on, and holding it in the on-state even after the starting switch is turned off;

a photodiode for emitting light by being supplied with a current when the first switching transistor is in the on-state;

a photo-triac connected between a gate and an anode or a cathode of the triac and optically coupled to the photodiode so that the photo-triac is turned on by light emitted by the photodiode to supply the triac with a gate current;

a second switching transistor, responsive to the determination by the first determination unit that the load current exceeds the first reference value, for bypassing a current of the photodiode to extinguish the photodiode even when the first switching transistor is in the on-state; and

a unit, responsive to the determination by the first determination unit that the load current is reduced below the first reference value after the load current exceeded the first reference value, for turning off the second switching transistor at a predetermined time after the determination.

14. (Previously Presented) An electric drill apparatus, comprising:

a motor for rotating an annular cutter;

a main switching element connected in series between the motor and a power supply;

a current detector for detecting a load current flowing through the motor;

a determination unit for determining a first condition whether to turn the main switching element off and a second condition whether to turn the main switching element on; and

a control unit for controlling the main switching element to turn on/off, wherein when the determination unit determines the first condition is met, the control unit turns off the main switching element to shut off the current flowing through the motor, and subsequently when the determination unit determines a second condition is met, the control unit turns on the main switching element after waiting at least a predetermined time after the determination, to supply the current from the power supply to the motor.

15. (Previously presented) An electric drill apparatus according to Claim 14, wherein the first condition comprises the load current exceeding a reference value and the second condition comprises the load current being less than the reference value.

16. (New) An electric drill apparatus according to Claim 1, wherein a main body of the annular cutter is substantially non-tapered.

17. (New) An electric drill apparatus according to Claim 5, wherein a main body of the annular cutter is substantially non-tapered.

18. (New) An electric drill apparatus, comprising:

a motor for rotating an annular cutter;

a main switching element connected between the motor and a power supply;

a current detector for detecting a load current flowing through the motor;

a determination unit for determining whether the load current detected by the current detector exceeds a reference value to turn off the electric drill; and

a control unit for controlling the main switching element to turn on/off, wherein when the determination unit determines that the load current exceeds the reference value to turn off the electric drill, the control unit turns off the main switching element to shut off the current flowing through the motor, and subsequently when the determination unit determines that the load current decreases to be smaller than a reference value to turn on the electric drill, the control unit turns on the main switching element after waiting at least a predetermined time after the determination, to supply the current from the power supply to the motor, wherein the control unit comprises:

an on-state self hold unit including a first switch, for turning on the first switch when a starting switch is turned on, and holding it in the on-state even after the starting switch is turned off;

a photodiode for emitting light when the first switching transistor is in the on-state;

a second switch, responsive to the determination by the determination unit that the load current exceeds the reference value to turn off the electric drill, for modifying a current of the photodiode even when the first switch is in the on-state; and

a unit, responsive to the determination by the determination unit that the load current is reduced below the reference value to turn on the electric drill after the load

current exceeded the reference value to turn off the electric drill, for turning off the second switch at the predetermined time after the determination.

19. (New) An electric drill apparatus according to Claim 18, wherein the main switching element comprises a triac.
20. (New) An electric drill apparatus according to Claim 19, wherein the control unit further comprises a photo-triac connected between a gate and an anode or a cathode of the triac and optically coupled to the photodiode so that the photo-triac is turned on by light emitted by the photodiode to supply the triac with a gate current.
21. (New) An electric drill apparatus according to Claim 20, wherein the first switch comprises a switching transistor and the second switch comprises a second switching transistor.
22. (New) An electric drill apparatus according to Claim 21, wherein the second switch bypasses the current of the photodiode in order to extinguish the photodiode when the first determination unit determines that the load current exceeds the reference value to turn off the electric drill.
23. (New) An electric drill apparatus according to Claim 22, wherein the reference value to turn off the electric drill is equal to the reference value to turn on the electric drill.